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Attorney's Docket No.: 07844-495001 / P459

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant : Todor Georgiev
Serial No. : 09/996,200
Filed : November 28, 2001
Title : A TOOL FOR EXTRACTING AND MANIPULATING COMPONENTS OF WARPING TRANSFORMS

Art Unit : 2672
Examiner : Ryan R. Yang

Mail Stop Appeal Brief - Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

BRIEF ON APPEAL

(1) Real Party in Interest

Adobe Systems Incorporated

(2) Related Appeals and Interferences

None known.

(3) Status of Claims

Claims 1-39 are pending in the case. (See Appendix of Claims.) Claims 1-3, 10-11, 13-18, 25-26, 28-32, 34-35, and 37-39 were rejected under 35 U.S.C. 102(b) as having been anticipated by Thomas et al. (ACM, Nov 1995). Claims 4, 19 and 36 were rejected under 35 U.S.C. § 103(a) as havinge been unpatentable over Thomas et al. in view of Reyzin (U.S. 6,215,915). Claims 5 and 6 were rejected under 35 U.S.C. § 103(a) as having been unpatentable over Thomas in view of Foley et al (Computer Graphics: Principles and Practice, 2nd Edition). Claims 20-24 were rejected under 35 U.S.C. § 103(a) as having been unpatentable over Thomas and Reyzin in view of Foley. Claims 12, 27, and 33 were rejected under 35 U.S.C. § 103(a) as

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having been unpatentable over Thomas in view of Choi et al. (U.S. 6,157,750). Claims 7-9 were objected to as being dependent upon a rejected base claim, but would have been allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims. All of the pending claims are being appealed.

(4) Status of Amendments

No substantive amendments have been made since the final office action dated March 13, 2004.

(5) Summary of Claimed Subject Matter

A variety of computer programs, such as Adobe® Photoshop® available from Adobe Systems Incorporated, provide tools that aid a user in distorting an image for visual effect. [specification, page 1, lines 7-9] Initially, an unaltered image (also referred to as a "source image") is associated with a distortion grid having zero distortion vectors. [specification, page 1, lines 13-14] Once the user applies a distortion to the source image, the altered image is referred to as a distorted image, which is associated with a distortion grid having a distortion vector. [specification, page 1, lines 11-12] Collectively, the distortion vectors indicate how the distorted image can be manipulated to obtain the source image. [specification, page 1, lines 12-13] As each distortion is sequentially applied to the distorted image, distortion vectors are added to the distortion grid and summed with the distortion vectors already in the distortion grid. [specification, page 1, line 16] In other words, the distortion vectors in the distortion grid at any point in time provide a sum of all previous distortion vectors, without the history of the individual distortions themselves. [specification, page 1, lines 16-18] Each distortion vector has one or more of the following components: translation, magnification, rotation, directional scaling, and skew. [specification, page 2, line 30 – page 3, line 1]

The appellant's claimed subject matter relates to techniques for extracting one or more components of a distortion local to a first area of a distorted image, and applying the extracted components to a second area of the distorted image. [specification, page 3, lines 4–5] A user uses a tool to select: (1) an area of a distorted image; and (2) one or more components to be extracted from the selected area. [specification, page 4, lines 19-26] The tool uses a plurality of

points local to the selected area to approximate an affine transformation that represents the distortion vectors local to the selected area. [specification, page 5, line 1 – page 6, line 14] The tool then manipulates the affine transformation to extract a matrix representing the user-selected components. [specification, page 6, line 19 – page 11, line 2] In response to a user action, the extracted matrix is applied by the tool to a second area of the distorted image to further distort the image. [specification, page 11, line 6 – page 12, line 3]

Claim 1 recites a method including: in response to user action on a canvas, selecting at least one area of a first image which relates to an area on a distortion grid [specification, page 4, lines 23-26]; using a plurality of points local to the at least one area to calculate a distortion [specification, page 4, line 27 – page 6, line 18]; extracting at least one component of the distortion [specification, page 6, line 19 – page 11, line 2]; and applying the at least one component to a second area of the first image [specification, page 11, line 4 – page 12, line 3].

Claim 16 recites a computer program product, disposed in a computer readable medium, having instructions to cause a computer to use a plurality of points surrounding a first area of an image related to an area in a distortion grid to calculate at least one component of a distortion at the first area [specification, page 4, line 23 – page 11, line 2]; and apply the at least one component of the distortion to a second area of the image [specification, page 11, line 4 – page 12, line 3].

Claim 31 recites a computer program product having instructions stored in a computer readable medium, containing instructions to cause a computer to display a first image on a canvas, the first image being related to an area on a distortion grid [specification, page 4, lines 13-22]; responsive to an input device controlled by a user, select an area of the first image [specification, page 4, lines 23-26]; responsive to a selection by the user from a menu, extract at least one component of a distortion from the area [specification, page 6, line 19 – page 11, line 2]; and responsive to movement and location of a cursor controlled by the user, apply the at least one component to a second area of the first image [specification, page 11, line 4 – page 12, line 3].

(6) Grounds of Rejection to be Reviewed on Appeal

The grounds of rejection to be reviewed on appeal are:

1. Did the examiner properly reject claims 1-3, 10-11, 13-18, 25-26, 28-32, 34-35, and 37-39 under 35 U.S.C. 102(b) as being anticipated by Thomas et al. (ACM, Nov 1995)?
2. Did the examiner properly reject claims 4, 19, and 36 under 35 U.S.C. § 103(a) as being unpatentable over Thomas et al. in view of Reyzin (U.S. 6,215,915)?
3. Did the examiner properly reject claims 5 and 6 under 35 U.S.C. § 103(a) as being unpatentable over Thomas in view of Foley et al (Computer Graphics: Principles and Practice, 2nd Edition)?
4. Did the examiner properly reject claims 20-24 under 35 U.S.C. § 103(a) as being unpatentable over Thomas and Reyzin in view of Foley?
5. Did the examiner properly reject claims 12, 27, and 33 under 35 U.S.C. § 103(a) as being unpatentable over Thomas in view of Choi et al. (U.S. 6,157,750)?

(7) Argument

(a) Anticipation

For a reference to anticipate a claim, each element and limitation of the claim must be found in the reference. *Hoover Group, Inc. v. Custom Metalcraft, Inc.,* 66 F.3d 299, 302 (Fed. Cir. 1995). Thomas does not disclose all of the elements of the claims. For reference, a marked up version of Thomas including reference letters is provided in the appendix.

<u>The Thomas approach</u>

Thomas describes how effects based on cartoon animation principles, such as the principles of solidity, exaggeration, reinforcement, attachment, and reluctance, can be used to enhance the illusion of direct manipulation by strengthening the impression that users are manipulating "real" objects presented in a graphical interface. [Thomas, page 4 at "A" and page 11 at "B"]. Thomas discloses techniques that application programmers can use to implement such animation effects in interfaces. [Thomas, page 3 at "C"]

In examples described in Thomas, the techniques are implemented in a drawing editor that supports the creation of simple figures, such as lines and polygons, and allows simple editing operations, such as moving, scaling, and rotating, to be performed on the figures. [Thomas, page 4 at "D"] Figures 2, 3, 4, 5 and 6 (reproduced below for reference) provide examples of user interactions with the drawing editor before and after the techniques are implemented.

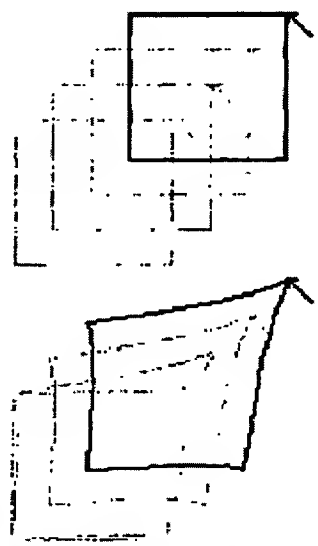

Figure 2: Animating a move operation

Figure 2 shows how the editor animates a move operation on a rectangle. Of course, these static images cannot fully convey the dynamic feel of the interaction; we have superimposed several successive frames from the interaction to suggest the effect. The top of the figure shows the operation without the animation effect; the rectangle merely moves to follow the mouse. The bottom shows the operation with animation; note how the corner of the rectangle stays attached to the mouse point while the bulk of the object lags slightly behind. In operation, the effect is that of manipulating a heavy "rubbery" object that distorts as it is pushed and pulled.

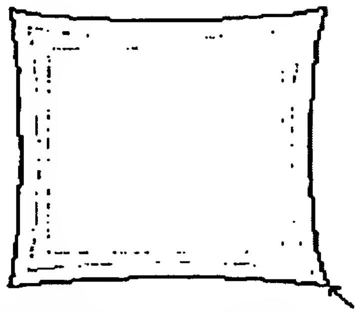

Figure 3: Animating a scaling operation

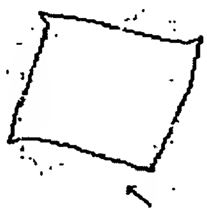

Figure 4: Animating a rotate operation

The same kind of effect works for other common editor operations. For example, figure 3 illustrates a scaling operation, and figure 4 shows a rotation. In each case, the editor uses the same strategy to animate the interaction; the part of the object that is "grabbed" is controlled by the mouse, while the bulk of the object lags behind. (For the scaling operation, we use an effect that suggests that all corners are simultaneously under the control of the mouse.)

The editor also supports simple constraining effects that show how animation can convey extra information about the interaction. Consider, for example, an attempt to move an object that is fixed in place. One response to this attempt might simply be to prevent the object from following the mouse. However, this lack of visible feedback might be misinterpreted as the result of a failure to "grasp" the object correctly. A user might make several attempts at the operation before realising the true cause of the lack of response. Another strategy might be to allow the object to follow the mouse, but then to snap it back to its original place when released. This approach avoids the problem with lack of feedback, but can lead to surprises when a carefully placed object suddenly jumps back.

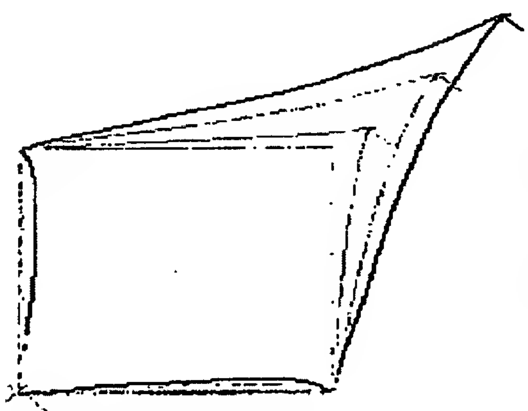

Figure 5: Attempting to move a pinned object

Figure 5 shows how our editor avoids both problems using animation. As the user attempts to drag the pinned object, the grab point stays attached to the mouse but the bulk of the object stays fixed. The effect is as if user is pulling on a corner of an object that is anchored in place. The feedback makes it clear that the user is attempting to move the object, but that the attempt will not succeed. When the grab point is released, the object will spring back to its original shape.

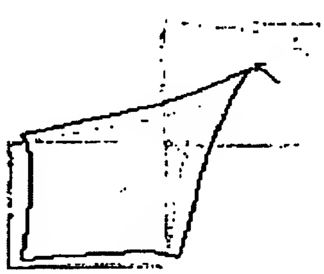

Figure 6: Moving under the influence of "gravity"

The same effect can suggest other constraints on objects. For example, figure 6 shows the effect of moving an object under the influence of a "gravity" field that causes the object to snap to a regular grid. As the user pulls the object away from a grid point, the grasped corner stretches while the object stays fixed. When pulled beyond a certain distance, the gravity suddenly "lets go" and the object snaps to the next grid point. Again, the feedback makes it clear what the current state of the interaction is, what the user must do to achieve the desired result, and what will happen if the object is released at any time.

To create the effect of animated interactions, Thomas describes creating and storing a number of warping transformations in the drawing editor. [Thomas, page 6 at "E"] Each warping transformation is associated with a particular operation and can be characterized by a set of bound vectors (also referred to as "warp vectors") that describe the transformations applied to key points in the coordinate space. [Thomas, page 6 at "F"] Transformations for points that do not coincide with vectors are calculated by interpolating between the vectors. [Thomas, page 6 at "F"]

To suggest the effect of moving a rectangle, for example, the drawing editor selects the warping transformation associated with the move operation from the set of stored warping transformations, and computes the warp vectors for the move operation (using the formula reproduced below) for each frame of the interaction. The drawing editor applies the warp vectors to the coordinate system of the drawing space (as shown in Figures 11 and 12 reproduced below), and then draws the object as a simple rectangle on the warped coordinate system of the drawing space. When the rectangle is displayed on the screen, it appears distorted (as shown in Figure 8 reproduced below).

For example, consider the warp vectors for a move operation (figure 12). Since $|p_1| = 0$ and $p_2 = p_3 = p_4 = p$, the computation of the transformation simplifies as follows:

$$\begin{aligned} q' &= q + \sum_{i=1}^{n} w_{qi} p_i \\ &= q + w_{q1} p_1 + \sum_{i=2}^{n} w_{qi} p_i \\ &= q + 0 + p \sum_{i=2}^{n} w_{qi} \\ &= q + p(w_{q2} + w_{q3} + w_{w4}) \end{aligned}$$

```
Transformer t;
Warp w;
w.add_vector(100, 80, 0, 0);
w.add_vector(0, 80, -10, -10);
w.add_vector(0, 0, -10, -10);
w.add_vector(100, 0, -10, -10);
t.warp(&w);
```

Figure 11: Applying a warp for a move operation

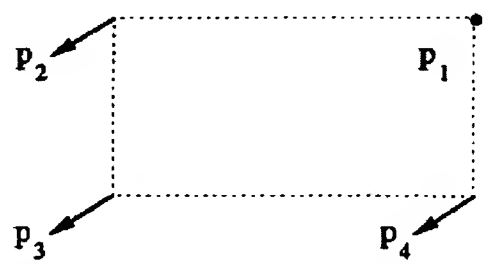

Figure 12: Symmetry of Translation Vectors

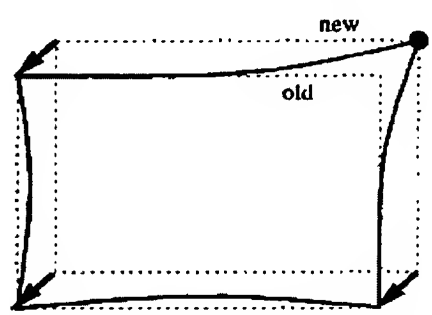

Figure 8: Calculating warp vectors for move

Group I (claims 1, 2, 10, 11, 16, 17, 25, 26, 31, 32, and 34)

For the purposes of this appeal only, claims 1, 2, 10, 11, 16, 17, 25, 26, 31, 32, and 34 rise and fall together. Claim 1, which is representative of this group, recites:

> **A method comprising:**
> **in response to user action on a canvas, selecting at least one area of a first image which relates to an area on a distortion grid;**
> **using a plurality of points local to the at least one area to calculate a distortion;**
> **extracting at least one component of the distortion; and**
> **applying the at least one component to a second area of the first image.**

In all of the examples described in Thomas, there is no mention of using a plurality of points local to an area of an image to calculate a distortion, extracting a component of the distortion, and applying the extracted component to a different area of the image.

As previously discussed, Thomas is directed to techniques for animating a user interaction with objects displayed in a graphical interface of an application. The Thomas approach involves storing warping transformations in a drawing editor and applying an appropriate warping transformation to an object displayed on a graphical interface in order to provide visual animated feedback to a user. There is no mention of calculating a distortion local to an area of an image, extracting a component of the distortion, and applying the extracted component to another area of the image.

The examiner's rejection of claim 1 as set forth in the Office Action mailed on March 12, 2004 is reproduced below for reference:

> **As per claim 1 ,Thomas et al., hereinafter Thomas, discloses a method comprising:**
> **in response to user action on a canvas, selecting at least one area of a first image which relates to an area on a distortion grid (Figure 3 where a corner of the object is grabbed for scaling);**
> **using a plurality of points local to the at least one area to calculate a distortion local to the area (Figure 3 where the area close to the selected corner is distorted; the distortion is not limited to one point but to a plurality of points local to the area);**
> **extracting at least one component of the distortion (the scaling factor for Figure 3); and**
> **applying the at least one component to a second area of the first image (Figure 3 where the other corners are also distorted).**

The appellant interprets the examiner's remarks with respect to claim 1 as saying that the drawing editor calculates an amount by which the corner of the object that is grabbed for scaling

is distorted, and applies this scaling amount to the other corners of the object. However, this is not what is described in Thomas.

Figure 3 and the related text say nothing about using a plurality of points local to an area of an image to calculate a distortion. Figure 3 of Thomas and the related text describe animating a scaling operation in which all four corners of a rectangle are simultaneously under the control of a mouse when one corner is dragged by a user of the mouse. Although these portions of Thomas neither disclose nor suggest the detail of how the animation of the scaling operation is performed, the appellant presumes that the techniques used are similar to those previously discussed in relation to animating a move operation. In other words, the drawing editor selects the warping transformation associated with the scaling operation from the set of stored warping transformations, computes the warp vectors for the scaling operation for each frame of the interaction, applies the computed warp vectors to the coordinate system of the drawing space, and draws the object on the warped coordinate system of the drawing space. When the object is displayed on the screen, it appears to be scaling outwards in the case of Figure 3.

In the Advisory Action mailed on May 3, 2004, the examiner responded to the appellant's remarks provided in the Reply to Action of March 12, 2004 as follows:

> **examiner notes in applicant's specification, applicant explains "distortion may be thought of as a grid of vectors ("the distortion grid"). Therefore, the grid is really a plurality of vectors. This is similar to Thomas' warp vectors (page 6, column 2, paragraph 4). Thomas also discloses distortion has components (Figure 9 has subroutine for rotation, scaling, and translation).**

The appellant disagrees with the examiner's assertion that the appellant's "distortion grid" is similar to Thomas' "warp vectors". As stated in appellant's specification at page 1, lines 11-13:

> **A distortion may be thought of as a grid of vectors (the "distortion grid") with each vector corresponding to a single point in an image. The vectors indicate how the image is modified to obtain the original, undistorted source image.**

To the contrary, Thomas describes the warp vectors as being used to add animation to a user interaction with an object. The warp vectors are calculated and applied to an underlying coordinate system in order to effect a particular warp transformation. Thomas says nothing about the warp vectors being a distortion grid that indicates how an image can be modified to

obtain an original, undistorted image. Rather, Thomas describes applying the warp vectors in order to distort an image.

Arguably, the matrix formed by the application of successive affine transformations on an object in Thomas' system might be interprested as the appellant's "distortion grid". On page 8, Thomas states:

> **Conceptually, a Transformer represents a succession of discrete mapping steps applied one after the other. For example, a Transformer might represent a scaling followed by a translation followed by a rotation. One characteristic of affine mappings is that they can be computed as matrix products in a homogeneous coordinate system; as a consequence, any sequence of affine mappings can be represented as a single matrix operation. Because of this property, the original Transformer stored only a single 3 × 2 matrix; successive transformations on the Transformer modified the matrix to reflect the new aggregate operation. However, the warp mapping is not affine, and so combinations of transformations that involve warping cannot be represented as a single matrix. We modified the implementation of the Transformer class so that it keeps a list of transformation items; successive affine transformations are combined into a single matrix item as before, while warp transformations are represented by individual warp items.**

Even though Thomas describes the types of affine transformations, such as rotation, scaling, and translation, that may be applied to an object through the interface provided by the drawing editor, nowhere does Thomas describe extracting a rotation component or a scaling component or a displacement component from a distortion once the transformation has been applied, as required in claim 2. The 3x2 affine transformation matrix in Thomas suffers from the same drawbacks as the distortion grids described in the background of the appellant's specification, in that what exists in the 3x2 matrix represents the aggregate operation that has been performed on the original object, and does not reveal the history of the individual discrete mapping steps themselves.

Thus, Thomas neither discloses nor suggests that there be a calculation of a distortion, or that points local to the dragged corner be used in such a calculation. Nor does Thomas disclose or suggest extracting a component of the distortion. And Thomas does not disclose or suggest that it is such a component that is to be applied to a second area of an image. Accordingly, claims 1, 2, 10, 11, 16, 17, 25, 26, 31, 32, and 34 are not anticipated by Thomas.

<u>Group II (claims 3, 18, and 35)</u>

For the purposes of this appeal only, claims 3, 18, and 35 rise and fall together. Claim 3, which is representative of this group, recites:

> **The method of claim 2 wherein the extracting comprises calculating an affine transform from the plurality of points.**

The examiner's rejection of claim 3 as set forth in the Office Action is reproduced below for reference:

> **As per claim 3, Thomas demonstrated all the elements as applied to the rejection of dependent claim 2, supra, and further discloses the extracting comprises calculating an affine transform from the plurality of points (Figure 3 where scaling is one component of affine transformation and "The original Transformation object supported only affine transformation such as rotation, scaling, and translation", page 7, last paragraph).**

The cited portions of Thomas describe affine transformations that can be applied to an object. There is no mention of calculating an affine transform from a plurality of points in the cited portion of Thomas or in any other part of the Thomas reference. Thomas does not disclose at least this feature of claims 3, 18, and 35.

Group III (claims 13, 28, and 37)

For the purposes of this appeal only, claims 13, 28, and 37 rise and fall together. Claim 13, which is representative of this group, recites:

> **The method of claim 1 wherein the applying is to an entire image.**

The examiner's rejection of claim 13 as set forth in the Office Action is reproduced below for reference:

> **As per claim 13, Thomas demonstrated all the elements as applied to the rejection of independent claim 1, supra, and further discloses the applying is to an entire image (Figure 1 where the entire area can be applied).**

It is unclear from the examiner's objections to claim 13 what is meant by "Figure 1 where the entire area can be applied." Figure 1 of Thomas shows a screen image of the drawing editor being used to move an objection. Neither the cited portion of Thomas, nor any other portion of Thomas describe extracting a component of a distortion, much less applying the extracted component of the distortion to an entire image. Thomas does not disclose at least this feature of claims 13, 28, and 37.

Group IV (claims 14, 15, 29, 30, 38 and 39)

For the purposes of this appeal only, claims 14, 15, 29, 30, 38, and 39 rise and fall together. Claim 14, which is representative of this group, recites:

> **The method of claim 1 wherein the applying is to a second image.**

The examiner's rejection of claim 14 as set forth in the Office Action is reproduced below for reference:

> **As per claim 14, Thomas demonstrated all the elements as applied to the rejection of independent claim 1, supra, and further discloses the applying is to a second image ("The editor supports the creation of simple figures such as lines and polygons", page 4, line 43-44).**

The cited portion of Thomas describes the manner in which the drawing editor can be used to create a figure and editing operations (e.g., moving, scaling, and rotating) that may be performed with respect to the created figures. Neither the cited portion of Thomas, nor any other portion of Thomas describe extracting a component of a distortion from an area of an image, much less applying the extracted component of the distortion to a second image. Thomas does not disclose at least this feature of claims 14, 15, 29, 30, 38, and 39.

(b) Obviousness

It is well established that there must be some logical reason apparent from the evidence of record to justify combination or modification of references. *In re Regal*, 526 F.2d 1399 188, U.S.P.Q.2d 136 (C.C.P.A. 1975). In addition, even if all of the elements of claims are disclosed in various prior art references, the claimed invention taken as a whole cannot be said to be obvious without some reason given in the prior art why one of ordinary skill in the art would have been prompted to combine the teachings of the references to arrive at the claimed invention. Id. Even if the cited references show the various elements suggested by the examiner in order to support a conclusion that it would have been obvious to combine the cited references, the references must either expressly or impliedly suggest the claimed combination or the examiner must present a convincing line of reasoning as to why one skilled in the art would have found the claimed invention obvious in light of the teachings of the references. *Ex Parte Clapp*, 227 U.S.P.Q.2d 972, 973 (Board. Pat. App. & Inf. 1985).

Group V (claims 4, 19 and 36)

Claims 4, 19 and 36 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Thomas in view of Reyzin. For the purposes of this appeal only, claims 4, 19 and 36 rise and fall together. Claim 4, which is representative of this group, recites:

> **The method of claim 3 wherein the extracting further comprises decomposing the affine transform into a translation and a linear transform matrix.**

The examiner's rejection of claim 4 as set forth in the Office Action is reproduced below for reference:

> **As per claim 4, Thomas demonstrated all the elements as applied to the rejection of dependent claim 3, supra.**
>
> **Thomas discloses a method of distorting an area of an image using affine transformation. It is noted that Thomas does not explicitly disclose the extracting further comprises decomposing the affine transform into a translation and a linear transform matrix, however, this is known in the art as taught by Reyzin. Reyzin discloses a method of transformation in which the affine transformation is decomposed into a translation part and a linear transform matrix (column 3, line 15-30 where (Xo,Yo) is the translation part and M is the transform matrix).**

Reyzin discloses techniques for concurrently rotating, scaling, translating, skewing, shearing, or otherwise transforming an image via a sequence of one-dimensional transformations. [Reyzin, Abstract] Reyzin describes providing methods for general affine transformation of an image in two dimensions by generating an intermediate image via affine transformation of the source along a first axis, and then subjecting the intermediate image to affine transformation along a second axis. [Reyzin, column 2, lines 37-49]

One technique involves: (1) determining a mapping between coordinates in an intermediate image and those in a source image; (2) determining an intensity value for the pixel at each coordinate in the intermediate image; and (3) determining a mapping between coordinates in a destination image and those of the intermediate image. [Reyzin, column 2, line 50 – column 3, line 12] The resultant affine transformation is provided in the cited portion of

Reyzin (reproduced below for reference).

> According to further aspects of the invention, general affine transformations are effected in accord with the mathematical relation:
>
> $$\begin{bmatrix} x_s \\ y_s \end{bmatrix} = M \cdot \begin{bmatrix} x_d \\ y_d \end{bmatrix} + \begin{bmatrix} x_o \\ y_o \end{bmatrix}$$
>
> $$M = \begin{bmatrix} e_{11} & e_{12} \\ e_{21} & e_{22} \end{bmatrix}$$
>
> where
>
> (x_d, y_d) represents a coordinate in the destination image;
> (x_s, y_s) represents a coordinate in the source image;
> (x_o, y_o) is an offset to be effected by the transformation; and
> M is a transformation matrix.

The Reyzin and Thomas references do not individually or in combination disclose or suggest extracting a component of a distortion by calculating an affine transform from a plurality of points, much less decomposing the affine transform into a translation and a linear transform matrix. Accordingly, claims 4, 19, and 36 are patentable over Thomas in view of Reyzin.

<u>Group VI (claims 5 and 20)</u>

Claim 5 is rejected under 35 U.S.C. § 103(a) as being unpatentable over Thomas in view of Foley. Claim 20 is rejected under 35 U.S.C. § 103(a) as being unpatentable over Thomas and Reyzin in view of Foley. For the purposes of this appeal only, claims 5 and 20 rise and fall together. Claim 5, which is representative of this group, recites:

> **The method of claim 3 wherein the extraction of magnification comprises calculating the determinant of a linear transform matrix.**

The examiner's rejection of claim 5 as set forth in the Office Action is reproduced below for reference:

> **As per claim 5, Thomas demonstrated all the elements as applied to the rejection of dependent claim 3, supra.**
>
> **Thomas discloses a method of distorting an area of an image using affine transformation. It is noted that Thomas does not explicitly disclose the extraction of magnification comprises calculating the determinant of a linear transform matrix, however, this is known in the art as taught by Foley et al., hereinafter Foley. Foley discloses that "the determinant of the matrix tells us ... how much the cube is expanded or contracted by the transformation (page 1104, line 2-3).**

The cited portion of Foley describes calculating a determinant of a matrix to determine a volume change resulting from a transformation. However, the Thomas and Foley references do not individually or in combination disclose or suggest extracting a magnification component of a distortion by calculating an affine transform from a plurality of points and calculating the determinant of a linear transform matrix. Accordingly, claims 5 and 20 are patentable over the cited references.

Group VII (claims 6 and 21)

Claim 6 is rejected under 35 U.S.C. § 103(a) as being unpatentable over Thomas in view of Foley. Claim 21 is rejected under 35 U.S.C. § 103(a) as being unpatentable over Thomas and Reyzin in view of Foley. For the purposes of this appeal only, claims 6 and 21 rise and fall together. Claim 6, which is representative of this group, recites:

> **The method of claim 3 wherein the extraction of rotation comprises calculating an angle from the elements of a linear transform matrix.**

The examiner's rejection of claim 6 as set forth in the Office Action is reproduced below for reference:

> **As per claim 6, Thomas demonstrated all the elements as applied to the rejection of dependent claim 3, supra.**
>
> **Thomas discloses a method of distorting an area of an image using affine transformation. It is noted that Thomas does not explicitly disclose the extraction of rotation comprises calculating an angle from the elements of a linear transform matrix, however, this is known in the art as taught by Foley. Foley discloses that in affine transformation, an angle of rotation from the transformation can be derived (page 203, the whole page).**

The cited portion of Foley describes deriving a rotation equation. However, the Thomas and Foley references do not individually or in combination disclose or suggest extracting a rotation component of a distortion by calculating an angle from the elements of a linear transform. Accordingly, claims 6 and 21 are patentable over the cited references.

Group VIII (claims 22, 23, and 24)

Claims 22-24 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Thomas and Reyzin in view of Foley. For the purposes of this appeal only, claims 22-24 rise and fall together. Claim 22, which is representative of this group, recites:

> **The computer program product of claim 19 wherein the one component of the distortion is a scaling amount, and the instructions to cause the computer to decompose the affine transformation further comprise instructions to calculate a pair of eigenvalues of the linear transform matrix, and wherein each eigenvalue represents the amount of scaling in a direction represented by a corresponding projection matrix.**

The examiner's rejection of claim 22 as set forth in the Office Action is reproduced below for reference:

> **As per claim 22, Thomas and Reyzin demonstrated all the elements as applied to the rejection of dependent claim 19, supra.**
>
> **Thomas and Reyzin disclose a method of distorting an area of an image using affine transformation. It is noted that Thomas and Reyzin do not explicitly disclose the one component of the distortion is a scaling amount, and the instructions to cause the computer to decompose the affine transformation further comprise instructions to calculate a pair of eigenvalues of the linear transform matrix, and wherein each eigenvalue represents the amount of scaling in a direction represented by a corresponding projection matrix, however, this is known in the art as taught by Foley. Foley disclose that, in affine transformation, eigenvector of the transformation can be calculated and it value is a scalar multiple of the vector derived from the transformation (page 1108-1109, A.6).**

The cited portion of Foley describes calculating an eigenvalue of a transformation. However, the Thomas, Reyzin and Foley references do not individually or in combination disclose or suggest extracting a scaling component of a distortion by calculating a pair of eigenvalues of the linear transform matrix. Accordingly, claims 22-24 are patentable over the cited references.

Group IX (claims 12, 27 and 33)

Claims 12, 27 and 33 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Thomas in view of Choi. For the purposes of this appeal only, claims 12, 27 and 33 rise and fall together. Claim 12, which is representative of this group, recites:

> **The method of claim 1 wherein a user selects the area for the applying by the location of a virtual brush.**

The examiner's rejection of claim 12 as set forth in the Office Action is reproduced below for reference:

> **As per claim 12, Thomas demonstrated all the elements as applied to the rejection of independent claim1, supra.**
>
> **Thomas discloses a method of distorting an area of an image using affine transformation. It is noted that Thomas does not explicitly disclose a user selects the area for the applying by the location of a virtual brush, however, this is known in the art as taught by Choi et a., hereinafter Choi. Choi discloses a method of transforming a basic shape element of a character by using a virtual brush (Figure 2 where the brush selects area to be transformed).**

Choi discloses a transformation method for generating a new shape of a prescribed size where the important form of the original shape, such as the thickness of the stroke, is maintained from the original shape. Choi does not disclose or suggest providing a virtual brush that a user can use to select an area to which the extracted component is applied. The only mention of a brush in the Choi reference is in column 4, lines 58 to 62, which describes a medial axis of a character as being a curve drawn by the tip of a brush and the radius information of the medial axis transformation being the size information of how much the brush is pressed down.

The Thomas and Choi references do not individually or in combination disclose or suggest the features of claim 12. Accordingly, claims 12, 27, and 33 are patentable over the cited references.

The brief fee of $340 is enclosed along with a check in the amount of $430 for a Petition for Extension of Time. Please apply any other charges or credits to Deposit Account No. 06-1050.

Respectfully submitted,

Date: 10/7/04

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Appendix of Claims

1. A method comprising:

in response to user action on a canvas, selecting at least one area of a first image which relates to an area on a distortion grid;

using a plurality of points local to the at least one area to calculate a distortion;

extracting at least one component of the distortion; and

applying the at least one component to a second area of the first image.

2. The method of claim 1 wherein the at least one component of the distortion is one of displacement, rotation, magnification, skew and directional scaling.

3. The method of claim 2 wherein the extracting comprises calculating an affine transform from the plurality of points.

4. The method of claim 3 wherein the extracting further comprises decomposing the affine transform into a translation and a linear transform matrix.

5. The method of claim 3 wherein the extraction of magnification comprises calculating the determinant of a linear transform matrix.

6. The method of claim 3 wherein the extraction of rotation comprises calculating an angle from the elements of a linear transform matrix.

7. The method of claim 3 wherein the extraction of scaling comprises calculating a pair of eigenvalues of a linear transform matrix, and wherein each eigenvalue represents the amount of scaling in a direction represented by a corresponding projection matrix.

8. The method of claim 7 wherein a rotation is removed from the linear transform matrix prior to calculating the pair of eigenvalues.

9. The method of claim 7 wherein a skew is removed from the linear transform matrix prior to calculating the pair of eigenvalues.

10. The method of claim 1 wherein a user selects the at least one component.

11. The method of claim 10 wherein the user selects the at least one component from a menu displayed on a user interface.

12. The method of claim 1 wherein a user selects the area for the applying by the location of a virtual brush.

13. The method of claim 1 wherein the applying is to an entire image.

14. The method of claim 1 wherein the applying is to a second image.

15. The method of claim 14 wherein the second image is different from the first image.

16. A computer program product, disposed in a computer readable medium, having instructions to cause a computer to:

using a plurality of points surrounding a first area of an image related to an area in a distortion grid, calculate at least one component of a distortion at the first area; and

apply the at least one component of the distortion to a second area of the image.

17. The computer program product of claim 16 wherein the at least one component of the distortion is one of displacement, rotation, magnification, skew and directional scaling.

18. The computer program product of claim 17 further comprising instructions to cause a computer to calculate an affine transform from the plurality of points.

19. The computer program product of claim 18 further comprising instructions to cause the computer to decompose the affine transform into a translation and a linear transform matrix.

20. The computer program product of claim 19 wherein the one component of the distortion is a magnification amount, and the instructions to cause the computer to decompose the affine transformation further comprise instructions to calculate the determinant of the linear transform matrix.

21. The computer program product of claim 19 wherein the one component of the distortion is an angular rotation amount, and the instructions to cause the computer to decompose the affine transformation further comprise instructions to calculate an angle from the elements of the linear transform matrix.

22. The computer program product of claim 19 wherein the one component of the distortion is a scaling amount, and the instructions to cause the computer to decompose the affine transformation further comprise instructions to calculate a pair of eigenvalues of the linear transform matrix, and wherein each eigenvalue represents the amount of scaling in a direction represented by a corresponding projection matrix.

23. The computer program product of claim 22 wherein rotation is removed from the linear transform matrix prior to calculating the pair of eigenvalues.

24. The computer program product of claim 22 wherein skew is removed from the linear transform matrix prior to calculating the pair of eigenvalues.

25. The computer program product of claim 16 wherein a user selects the at least one component.

26. The computer program product of claim 25 wherein the user selects the at least one component from a menu displayed on a user interface.

27. The computer program product of claim 16 wherein the area for the applying is selected by a user, responsive to the movement of a virtual brush.

28. The computer program product of claim 16 wherein the component is applied to an entire image.

29. The computer program product of claim 16 wherein the component is applied to a second image.

30. The computer program product of claim 16 wherein the second image is different from the first image.

31. A computer program product having instructions stored in a computer readable medium, containing instructions to cause a computer to:

display a first image on a canvas, the first image being related to an area on a distortion grid;

responsive to an input device controlled by a user, select an area of the first image;

responsive to a selection by the user from a menu, extract at least one component of a distortion from the area; and

responsive to movement and location of a cursor controlled by the user, apply the at least one component to a second area of the first image.

32. The computer program product of claim 31 wherein the input device is a mouse.

33. The computer program product of claim 32 where the cursor comprises a virtual paintbrush.

34. The computer program product of claim 31 wherein the at least one component of the distortion is one of displacement, rotation, magnification, skew and directional scaling.

35. The computer program product of claim 31 further comprising instructions to cause a computer to calculate an affine transform from the plurality of points.

36. The computer program product of claim 35 further comprising instructions to cause the computer to decompose the affine transform into a translation and a linear transform matrix.

37. The computer program product of claim 31 wherein the components is applied to an entire image.

38. The computer program product of claim 31 wherein the component is applied to a second image.

39. The computer program product of claim 31 wherein the second image is different from the first image.